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(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
5 February 2004 (05.02.2004)

PCT

(10) International Publication Number
WO 2004/012043 A2

(51) International Patent Classification[7]: G06F

(21) International Application Number:
PCT/US2003/023121

(22) International Filing Date: 24 July 2003 (24.07.2003)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
10/205,965 26 July 2002 (26.07.2002) US

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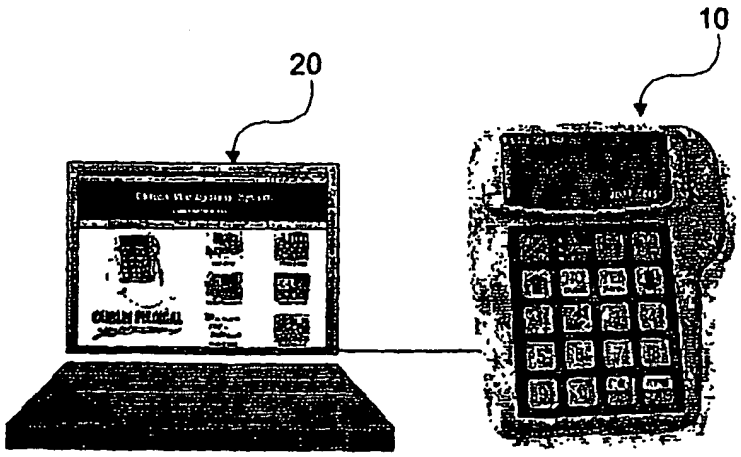
(81) Designated States *(national)*: AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, UZ, VC, VN, YU, ZA, ZM, ZW.

(84) Designated States *(regional)*: ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IT, LU, MC, NL, PT, RO, SE, SI, SK, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:
— *without international search report and to be republished upon receipt of that report*

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: SYSTEM AND METHOD FOR REMOTELY OPERATING A PERISTALTIC PUMP



(57) Abstract: A method of storing on a remote storage device protocol information for a drug for administration via a peristaltic pump is disclosed. A communications path between the peristaltic pump and the remote storage device is provided. The protocol information for the drug is entered into the peristaltic pump. The protocol information is transferred from the peristaltic pump to the remote storage device. The protocol information for the drug is stored on the remote storage device. History information may be retrieved from the peristaltic pump. A user request is received requesting retrieval of history information from the peristaltic pump. A pump request is formatted to retrieve history information. The pump request to receive history information is transmitted to the peristaltic pump. The history information is received from the peristaltic pump. The history information is displayed and stored.

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SYSTEM AND METHOD FOR REMOTELY OPERATING A PERISTALTIC PUMP

CROSS-REFERENCE TO RELATED APPLICATIONS

(Not Applicable)

STATEMENT RE: FEDERALLY SPONSORED RESEARCH/DEVELOPMENT

(Not Applicable)

BACKGROUND OF THE INVENTION

The present invention relates generally to medical infusion pumps and more particularly to a system and method for remotely controlling a peristaltic pump.

Traditionally infusion pumps have been used to deliver medications and fluids to patients, intravenously subcutaneously or Epidural, according to a controlled rate and dose schedule. Such infusion or peristaltic pumps are known in the art. Peristaltic pumps may be linear, such as those described in U.S. Patent No. 2,877,714 (Sorg, et. al), U.S. Patent No. 4,671,792 (Borsannyi), U.S. Patent No. 4,893,991 (Canon), rotary, such as those described in U.S. Patent No. 4,886,431 (Soderquist et al.) and U.S. Patent No. 3,172,367 (Kling) or curvilinear, such as is described in U.S. Patent No. 6,164,921 (Moubayed et al.).

The pump is normally programmed by a clinician based on a specific patient prescription. The pump is traditionally programmed through a user interface keypad on the pump.

There have been some efforts in the past to establish capabilities of remotely programming the pump through a modem and transferring data through telephone lines. For example, Mediview, which is currently owned by Baxter, provides remote programming capabilities of the Homerun 6060 pump through a modem and telephone line, It allows the clinician to view, at a remote location, the 6060 pump simulated on a computer monitor with its display and keypad. The clinician can view the display of the remote pump on a computer monitor and can interact with the pump using a mouse and keyboard. Remote programming systems, such as those described above may be difficult to program and do not reduce infusion errors.

Thus, there is a need for a system and method for programming a peristaltic pump which reduces infusion errors. The system should also be easy to program, i.e., should not require significant training by the clinician.

BRIEF SUMMARY OF THE INVENTION

An aspect of the present invention may be regarded as a method of storing on a remote storage device protocol information for a drug for administration via a peristaltic pump. The method provides a communications path between the peristaltic pump and the remote storage device. The protocol information for the drug is entered into the peristaltic pump. The protocol information is transferred from the peristaltic pump to the remote storage device. The protocol information for the drug is stored on the remote storage device.

The protocol information may be stored in a drug library on the remote storage device. The protocol information may be selected from the drug library and sent to the peristaltic pump for administration to a patient. The protocol information may be copied from the drug library to a patient library. The protocol information may be exported from the drug library. The exported protocol information may be sent to another user, for example, via e-mail. The protocol information in the drug library may be edited.

The protocol information may be stored in a patient library on the remote storage device. The protocol information may be selected from the patient library and sent to the peristaltic pump for administration to a patient. The protocol information may be exported from the patient library. The protocol information in the patient library may be edited.

The protocol information for the drug may include associated warnings and precautions.

The remote storage device is a personal computer, such as a laptop computer. The remote storage device may be a handheld storage device, such as a Personal Digital Assistant (PDA).

A current date/time and/or maintenance date may be entered.

Calibration functions may be invoked.

Another aspect of the present invention may be regarded as a method for receiving history information from a peristaltic pump. A user request is received

requesting retrieval of history information from the peristaltic pump. A pump request is formatted to retrieve history information. The pump request to receive history information is transmitted to the peristaltic pump. The history information is received from the peristaltic pump. The history information is displayed.

The history information may be all of the history information stored in the peristaltic pump. The history information may be the latest prescription. The history information may be a predefined amount of history information, e.g., four kilobytes. The history information may be printed or exported for e-mail to others.

BRIEF DESCRIPTION OF THE DRAWINGS

These as well as other features of the present invention will become more apparent upon reference to the drawings wherein:

Figure 1A illustrates a first embodiment of the present invention wherein a peristaltic pump is in communication with a laptop computer;

Figure 1B illustrates a second embodiment of the present invention wherein the peristaltic pump of Figure 1A is in communication with a handheld computing device;

Figure 2 illustrates an example screen display showing the major functions of one embodiment of the present invention; and

Figures 3-9 illustrate exemplary screen displays for performing the various functions available from the display shown in Figure 2.

DETAILED DESCRIPTION OF THE INVENTION

Referring now to the drawings wherein the showings are for purposes of illustrating preferred embodiments of the present invention only, and not for purposes of limiting the same, Figures 1A and 1B illustrate a persistaltic pump in communication with a computer capable of programming the pump. The particular pump shown in the Figures is marketed by Curlin Medical of Huntington Beach, California and is described in U.S. Letters Patent 6,164,921, the disclosure of which is expressly incorporated herein by reference. User's manuals entitled "Curlin Medical 4000 Peristaltic Pump" and "350-9008B CMS User Manual" are incorporated herein by reference and are available from Curlin Medical of Huntington Beach, California. However, use of other ambulatory pumps is contemplated herein. Pumps, such as the

one shown in Figures 1A and 1B are typically stand-alone devices used to administer medication to a patient. The pump 10 shown in Figures 1A and 1B can be used as a stand-alone pump. Additionally, the pump shown in Figures 1A and 1B can communicate with a computer, such as a laptop computer 20 (shown in Figure 1A) or a handheld computer, such as a personal digital assistant (PDA) 30 (shown in Figure 1B).

The present invention helps reduce the risk of medication errors, reduces staff costs by enabling point- and-click, time-efficient programming of the pump, facilitates remote monitoring of the infusion process, provides an audit trail for billing, validation and archival purposes, and easily integrates into existing systems. The data management functions allow the clinician the ability to create, select, and use protocols and prescriptions, select and transfer personalized prescriptions to a PDA/Palm™ device, provide a "Drug Precautions" page for warnings, indications and instructions, compile data for further analysis, retrieve patient-history files, and generate customized reports from a PC or Palm device.

Preferably, the computing device 20 is a personal computer (PC) with at least a 486 Intel7 processor with a system speed of at least 90 MHz (megahertz). In preferred embodiments, the computing device 20 uses a Windows7 operating system, such as Windows7 95, 98, ME, 2000 or NT. The computing device 20 should have at least thirty-two (32) MB (megabytes) of random access memory (RAM) and at least eight (8) MB of available storage space. The computing device 20 preferably includes a compact disc read-only memory (CD-ROM) drive. Preferably, the computing device 20 includes a graphics card that is capable of a pixel resolution of 800 x 600 or better (e.g., super video graphics array (SVGA) or better). In addition to a keyboard, the computing device 20 preferably includes a pointing device, such as a mouse.

The pump shown in Figures 1A and 1B, like prior art pumps includes logic (software) for managing the pump.

In exemplary embodiments of the present invention, the computer 20 stores a drug library and a patient library. The drug library stores protocols classified by drug name, programmer name (person who stored the protocol), and creation date. A prescription or protocol can be selected from those stored in the drug library. The

prescription can then be sent to the pump attached to the computer. The protocol is then uploaded to the pump.

Figure 2 illustrates an example screen display showing the major functions of one embodiment of the present invention. Preferably, upon starting the program, the user is asked to enter a password. Details in setting up passwords and entering and validating password is not explained in further detail herein as techniques known in the art can be used for security aspects of the present invention including a user login function.

The exemplary screen display 100 shown in Figure 2 includes controls to access the major functions of the present invention. In the illustrated example, graphical depictions of the function are selected to invoke the various functions. It will be appreciated that other user interface controls, such as menus, could be used to access the functions. The selections available from the main menu shown in Figure 2 include: Drug Library 102, Patient Library 104, Create Prescription 106, Manage History 108, Peace of Mind 110 and Single Therapy 112. Each of theses functions is briefly summarized next and described in more detail later.

Pressing the Drug Library button 102 invokes the drug library function which allows the user to store and access protocols. Pressing the Patient Library button 102 invokes the patient library function which allows the user to store and access (e.g., copy and export) patient specific prescriptions. Pressing the Create Rx button 104 invokes the create prescription function which allows the user to enter and store information in the drug library or the patient library. Pressing the Manage History button 106 invokes the manage history function which allows the user to download the pump history for archiving, documentation, review or analysis. Pressing the Peace of Mind button 108 invokes the peace of mind function which downloads a recently programmed therapy for documentation, validation or verification. Pressing the Single Therapy button 110 invokes the single therapy function which converts the pump into a PCA, TPN, continuous, intermittent, or variable therapy pump for manual programming.

If the user presses the Drug Library button 102, an exemplary Drug Library Display 120 such as the one shown in Figure 3 is displayed so that the user can view or edit information for the prescription that was entered during create Rx. In the example shown, there is a list of stored protocols 122 which are identified by a drug

name, programmer and creation date. One of the stored protocols can be selected. Detailed information is then shown for the selected protocol. The detailed information includes comments 124 and drug precautions 126. The display includes controls, such as buttons, that allow the user to manipulate the data in the drug library.

In the exemplary embodiment, the user can press a Copy button 130 which allows the user to copy a protocol from the drug library to the patient library. When the copy button 130 is pressed, a window is displayed prompting for a patient's name. Entry and acceptance of a valid patient name causes the selected protocol to be copied to the patient library and stored under the entered patient's name.

Pressing an Import button 132 allows the user to import a protocol. This allows the user to store appropriately formatted files into the drug library. The files may be sent by another user.

Pressing an Export button 134 allows the user to export a selected protocol. The user can export the protocol to another user. In exemplary embodiments, the protocol is exported by sending it to the desired user via e-mail.

Pressing an Edit button 136 allows the user to edit an existing protocol. In exemplary embodiments, selection of the edit function causes two additional controls, e.g., buttons, to be displayed, namely, Delete and Save. The user can then edit the comments and/or precautions fields and save them by pressing the save button, if desired. In exemplary embodiments, the drug name, programmed by and creation date fields cannot be edited. The user may delete a protocol, if desired, by pressing the Delete button.

The user may also send the prescription to the pump by pressing a Send Rx to Pump button 140. Sending a prescription to the pump programs the pump with the prescription. Pressing the Send Rx to Pump button 140 causes the precaution window to display the precaution information for the protocol. The administrator of the prescription must review the precautions and indicate that the precautions have been reviewed by pressing the "Noted" button.

The user can also opt to Send a Prescription to the Palm™ by pressing the Select Rx for Palm button 150. In exemplary embodiments, selection of this function saves selected protocols into a directory for transfer to a Palm™ device. A cable is connected from the computer to the Palm™ device. In exemplary embodiments, the user selects the prescription to be sent to a HotSync folder. The files in the HotSync

folder can then be selected for transfer to the Palm™ device. In exemplary embodiments, all of the protocols being transferred to the Palm™ device are stored in one file, for example, a file named Patient.pdb. This file is then transferred to the Palm™ device. In exemplary embodiments, if there is an existing Patient.pdb file, it will be written over by the new file. Thus, the user must transfer all of desired protocols to the Palm™ device as the current ones will be overwritten.

If the user presses the Patient Library button 104, a patient library display 160 is displayed. In exemplary embodiments, such as the one shown in Figure 4, the patient library display 160 and functions (invoked by controls, such as buttons) are similar to those for the drug library. As with the drug library, the user can import, export or edit entries in the patient library. The user can send a prescription to the pump or transfer prescriptions to the Palm™ device.

Creating a prescription allows the user to store prescription information in the drug library or the patient library. This information is uploaded from the pump. The user presses the Create Prescription button 106 from the main display window 100. A create prescription window 180 such as the one shown in Figure 5 is displayed. The exemplary screen display shown in Figure 5 provides the user with an instruction window 182 which tells the user to: (1) connect and turn on the pump; (2) select library and fill in fields; and (3) program the pump.

A cable is used to connect the pump, for example, Curlin Medical 4000 CMS pump 10 is connected to the PC 20, by inserting the cable in the serial port of the PC. The user selects the desired library 184, i.e., the drug library or the patient library, for storing the protocol to be uploaded from the pump. The user also enters a drug name 186, a patient ID 188, comments 190 and precautions 192.

The user then presses a Begin Programming button 194 to begin programming the pump. The pump is programmed the same as during stand-alone operation of the pump. For example, if the pump is a Curlin Medical 4000 Plus pump, the pump is programmed according to the directions for that particular pump. The user's manual for the Curlin Medical 4000 Plus pump is included as a compact disc appendix and is incorporated herein by reference.

In exemplary embodiments, such as the one shown in Figure 6, protocol information, including keystrokes that are used when programming the pump, is stored. For example, when a menu is displayed and the user scrolls down, "DOWN"

is stored in the protocol file. Thus, when the information is uploaded to the pump, it is as if a user were using the keypad to enter the information directly into the pump except that the information is actually transmitted from the computer via the cable that connects the pump to the computer.

The computer stores history files. Peace of mind files include the latest programmed prescription.

If the user presses the Manage History button 108, the manage history function is invoked and all of the information stored in the pump 10 is downloaded to the computer 20. A manage patient history display 220 such as the one shown in Figure 7 is displayed. The user can either choose to retrieve the patient history 222 or to retrieve and then clear the patient history 224. If clear the patient history is selected, the history file will be deleted from the pump 10 after it is downloaded to the computer 20. After selecting one of these options, the user presses a Retrieve Now button 226 to retrieve the data from the pump. The names and creation dates of the downloaded history files are displayed in an existing history files window 228. The user can select a history file from the existing history file window 228. The data in the selected file is then displayed in a view history window 230. There are also controls (e.g., buttons) that allow the user to rename 232, export 234, delete 236 or print 238 a selected history file.

If the user presses the Peace of Mind button 112, a peace of mind function is invoked. The peace of mind function downloads and displays the most recently programmed therapy. This provides the clinician with proof (or peace of mind) that the therapy was uploaded into the pump. In exemplary embodiments, this features downloads the most recent four (4) kilobytes of data from the pump. An exemplary screen display 240 showing peace of mind data is shown in Figure 8.

The present invention also allows the pump to be utilized as a single therapy device. When the user presses the Single Therapy button 112, all but one therapeutic mode on the pump are disabled. For example, some hospitals only need a single mode, such as PCA. This feature can be used when the pump is being manually programmed. In exemplary embodiments, the user can select any available therapeutic mode as the single mode therapy, for example, Continuous, Intermittent, Multi Therapy, PCA, TPN, or Variable. The pump can be removed from single therapy mode manually or by selecting multi therapy.

Various maintenance activities may be performed on the pump using the present invention. For example, a current date/time may be entered and/or a maintenance date may be entered. The present invention may also be used to invoke calibration functions on the pump.

In exemplary embodiments, a palm computing device 30 may be used to perform a subset of the operations that can be performed by larger computing devices, such as a laptop computer 20. The Palm system can be used to program a pump 10 or to retrieve information from the pump. Protocols or prescriptions can be transferred to the PDA 30 from the PC 20 for bedside pump programming. Infusion information gathered by the pump 10 can be downloaded for later analysis.

While an illustrative and presently preferred embodiment of the invention has been described in detail herein, it is to be understood that the inventive concepts may be otherwise variously embodied and employed and that the appended claims are intended to be construed to include such variations except insofar as limited by the prior art.

CLAIMS

What is claimed is:

1. A method of storing on a remote storage device protocol information for a drug for administration via a peristaltic pump, the method comprising:

providing a communications path between the peristaltic pump and the remote storage device;

entering the protocol information for the drug into the peristaltic pump;

transferring the protocol information from the peristaltic pump to the remote storage device; and

storing the protocol information for the drug on the remote storage device.

2. The method of Claim 1, wherein storing the protocol information comprises storing the protocol information in a drug library on the remote storage device.

3. The method of Claim 2, further comprising:

selecting the protocol information from the drug library ; and

sending the selected protocol information to the peristaltic pump for administration to a patient.

4. The method of Claim 2, further comprising copying the protocol information from the drug library to a patient library.

5. The method of Claim 2, further comprising exporting the protocol information from the drug library.

6. The method of Claim 2, further comprising editing the protocol information in the drug library.

7. The method of Claim 1, wherein storing the protocol information comprises storing the protocol information in a patient library on the remote storage device.

8. The method of Claim 7, further comprising:

selecting the protocol information from the patient library; and

sending the selected protocol information to the peristaltic pump for administration to a patient.

9. The method of Claim 7, further comprising exporting the protocol information from the patient library.

10. The method of Claim 2, further comprising editing the protocol information in the patient library.

11. The method of Claim 1, wherein the protocol information for the drug includes associated warnings and precautions.

12. The method of Claim 1, wherein the remote storage device is a personal computer.

13. The method of Claim 12, wherein the remote storage device is a laptop computer.

14. The method of Claim 1, wherein the remote storage device is a handheld storage device.

15. The method of Claim 14, wherein the remote storage device is a personal digital assistant.

16. The method of Claim 1, further comprising setting the peristaltic pump into a single therapy mode.

17. The method of Claim 1, further comprising performing a maintenance activity on the peristaltic pump.

18. The method of Claim 17, wherein the maintenance activity comprises setting a current date and time on the peristaltic pump.

19. The method of Claim 17, wherein the maintenance activity comprises setting a maintenance date.

20. The method of Claim 17, wherein the maintenance activity comprises performing a calibration function.

21. A method for receiving history information from a peristaltic pump, the method comprising:

receiving a user request to retrieve history information from the peristaltic pump;

formatting a pump request to retrieve history information;

transmitting the pump request to the peristaltic pump;

receiving the history information from the peristaltic pump; and

displaying the history information.

22. The method of Claim 21, wherein the history information is all of the history information stored in the peristaltic pump.

23. The method of Claim 21, wherein the history information is a latest prescription.

24. The method of Claim 21, wherein the history information is a predefined amount of history information.

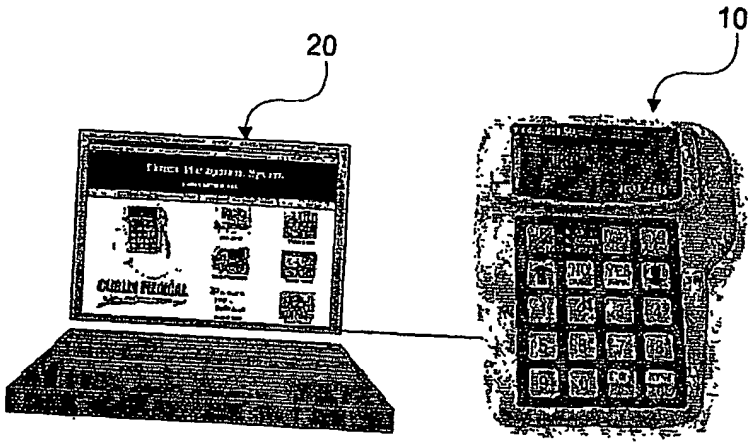

Fig. 1A

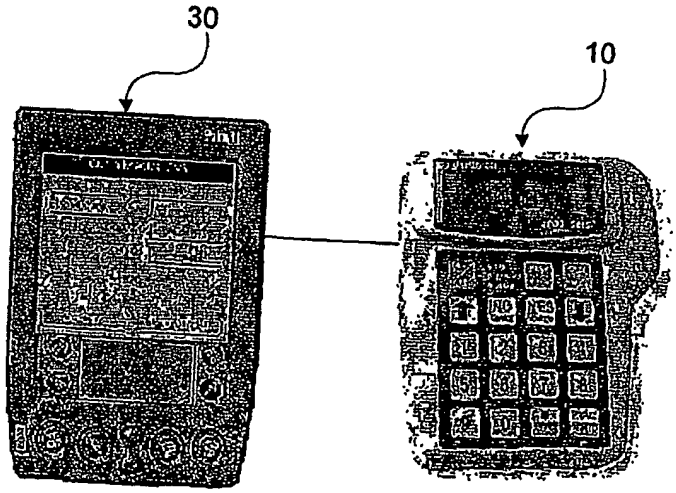

Fig. 1B

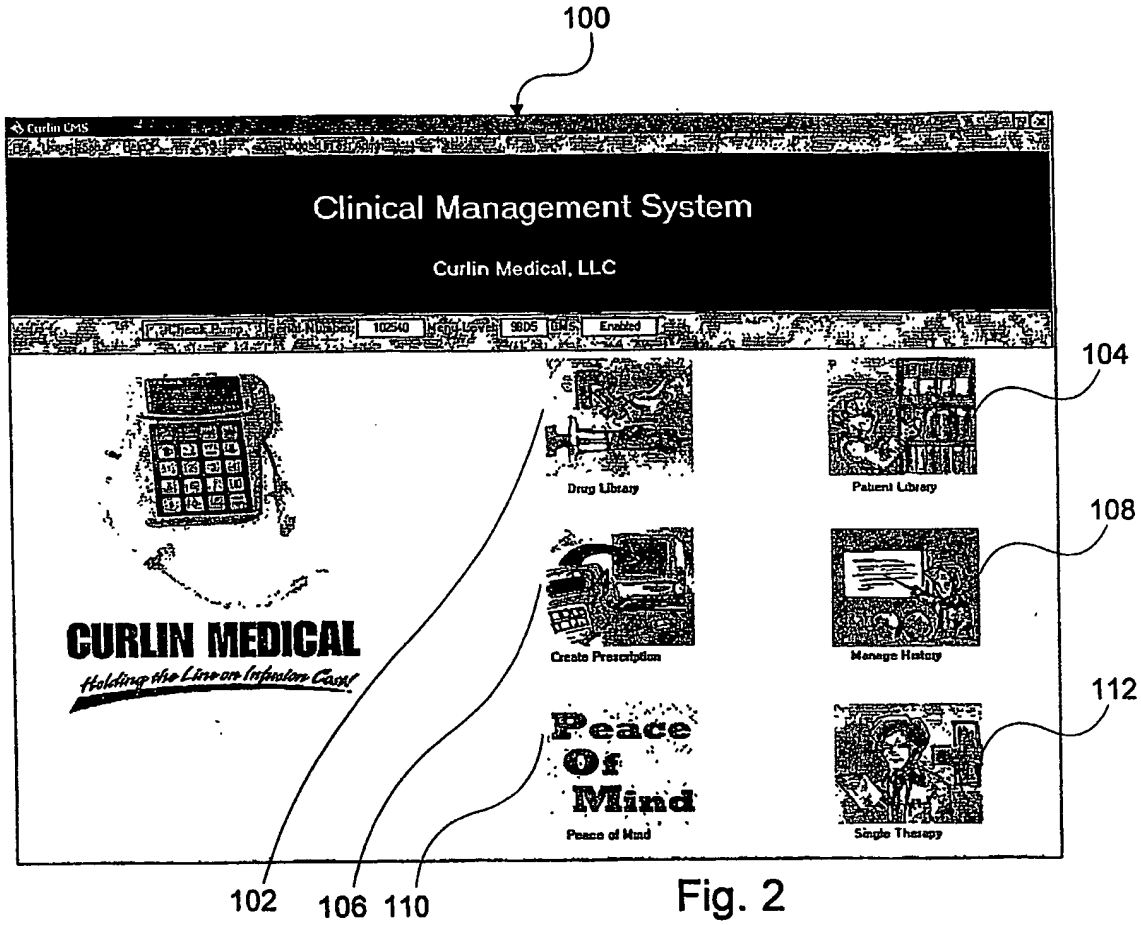
100
Clinical Management System
Curlin Medical, LLC
CURLIN MEDICAL
Holding the Line on Infusion Cost
Drug Library
Patient Library
Create Prescription
Manage History
Peace Of Mind
Peace of Mind
Single Therapy
102
106
110
104
108
112

Fig. 2

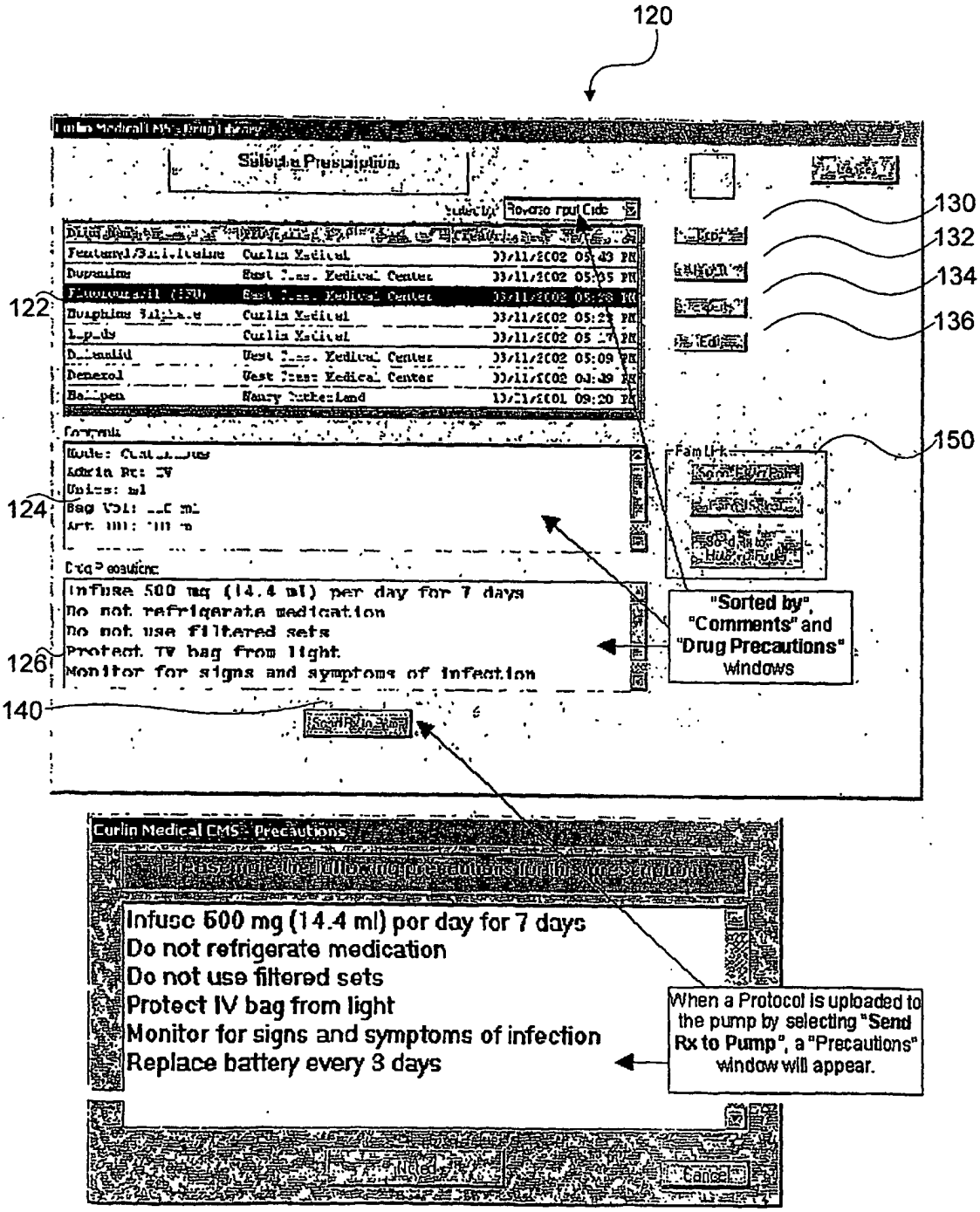
120
130
132
134
136
150
122
124
126
140
Select Prescription
Fentanyl/Sufentanil
Curlin Medical
Dopamine
West Texas Medical Center
Dobutamine
Curlin Medical
Lipids
Curlin Medical
Demerol
West Texas Medical Center
Ampicillin
Henry Sutherland
Drug Precautions
Infuse 500 mg (14.4 ml) per day for 7 days
Do not refrigerate medication
Do not use filtered sets
Protect IV bag from light
Monitor for signs and symptoms of infection
"Sorted by", "Comments" and "Drug Precautions" windows
Curlin Medical CMS - Precautions
Please note the following precautions for this prescription
Infuse 500 mg (14.4 ml) per day for 7 days
Do not refrigerate medication
Do not use filtered sets
Protect IV bag from light
Monitor for signs and symptoms of infection
Replace battery every 3 days
When a Protocol is uploaded to the pump by selecting "Send Rx to Pump", a "Precautions" window will appear.
Cancel

Fig. 3

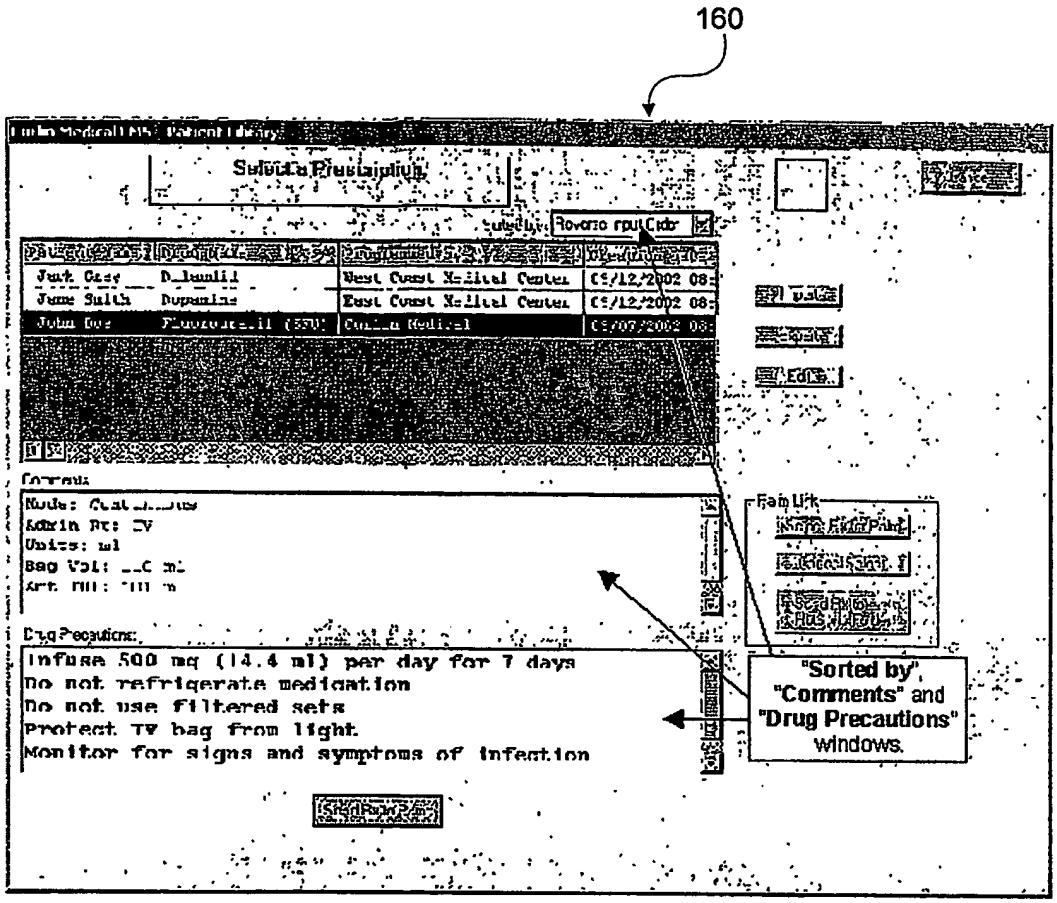
160
Infuse 500 mg (14.4 ml) per day for 7 days
Do not refrigerate medication
Do not use filtered sets
Protect IV bag from light.
Monitor for signs and symptoms of infection
"Sorted by", "Comments" and "Drug Precautions" windows.

Fig. 4

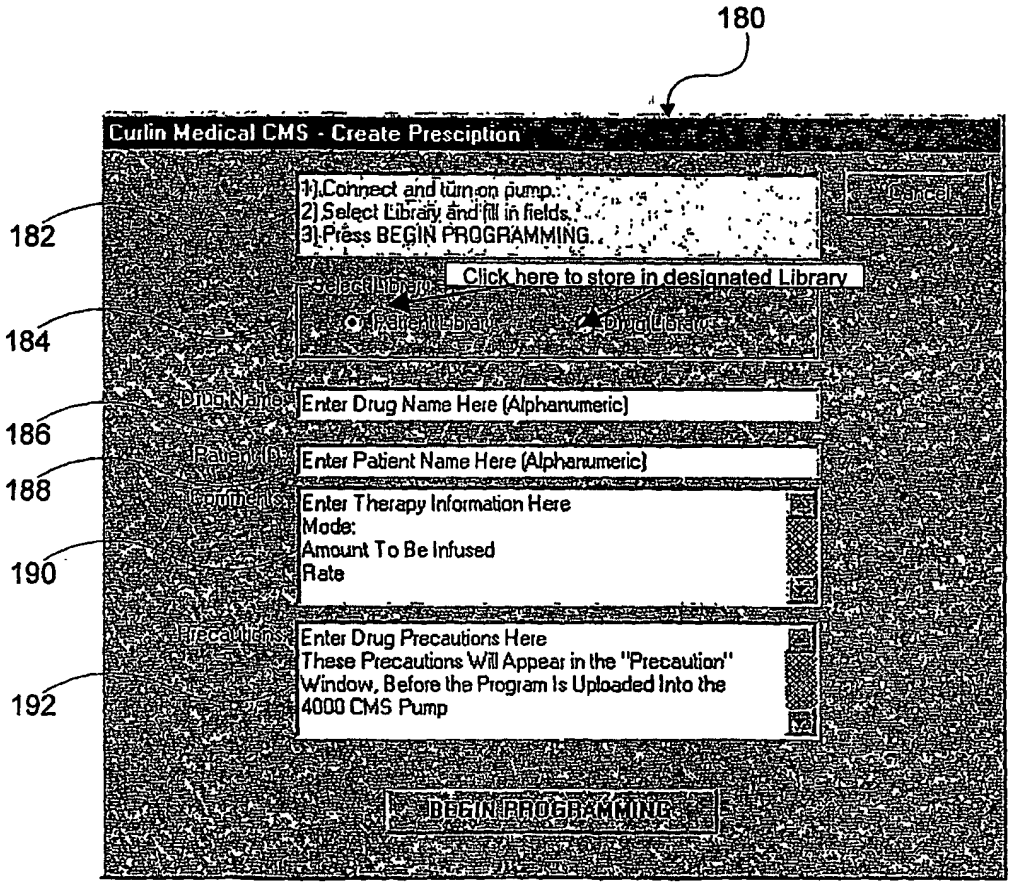
180
Curlin Medical CMS - Create Presciption
1) Connect and turn on pump.
2) Select Library and fill in fields.
3) Press BEGIN PROGRAMMING.
Cancel
182
Select Library
Click here to store in designated Library
184
Patient Library
Drug Library
Drug Name
Enter Drug Name Here (Alphanumeric)
186
Patient ID
Enter Patient Name Here (Alphanumeric)
188
Comments
Enter Therapy Information Here
Mode:
Amount To Be Infused
Rate
190
Precautions
Enter Drug Precautions Here
These Precautions Will Appear in the "Precaution" Window, Before the Program Is Uploaded Into the 4000 CMS Pump
192
BEGIN PROGRAMMING

Fig. 5

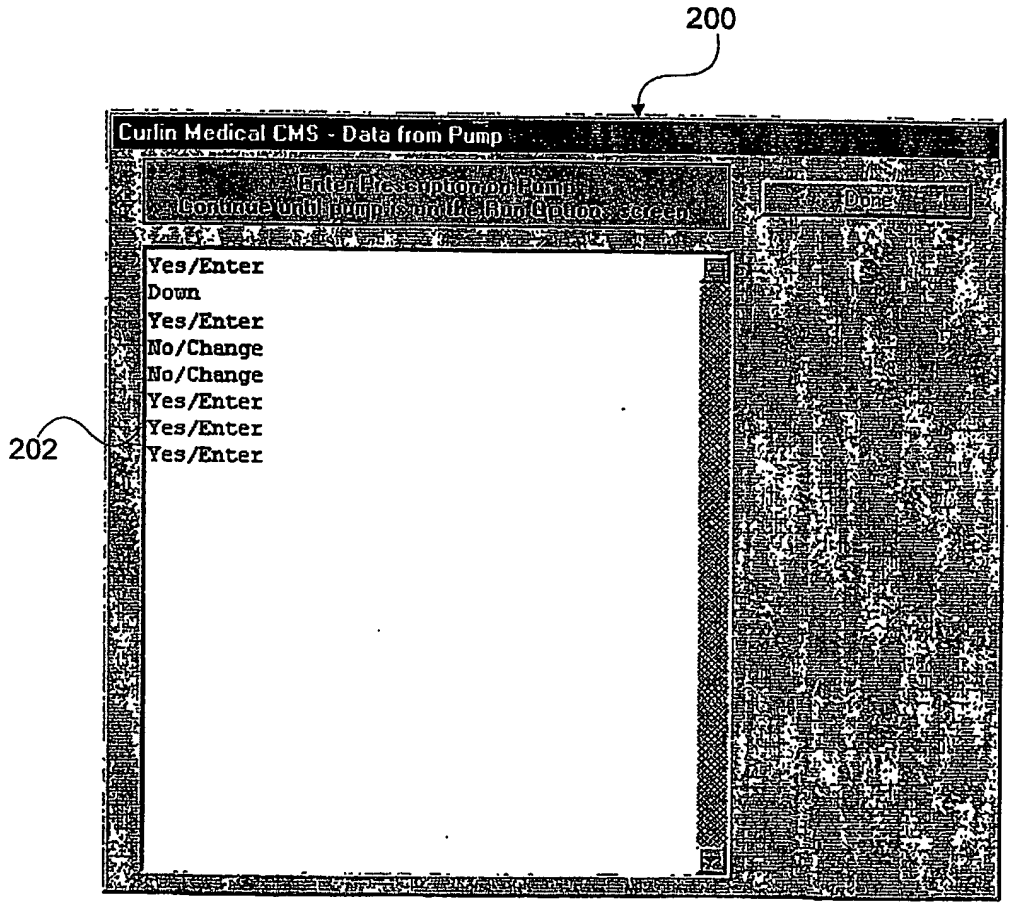
200
Curlin Medical CMS - Data from Pump
Done
Yes/Enter
Down
Yes/Enter
No/Change
No/Change
Yes/Enter
Yes/Enter
Yes/Enter
202

Fig. 6

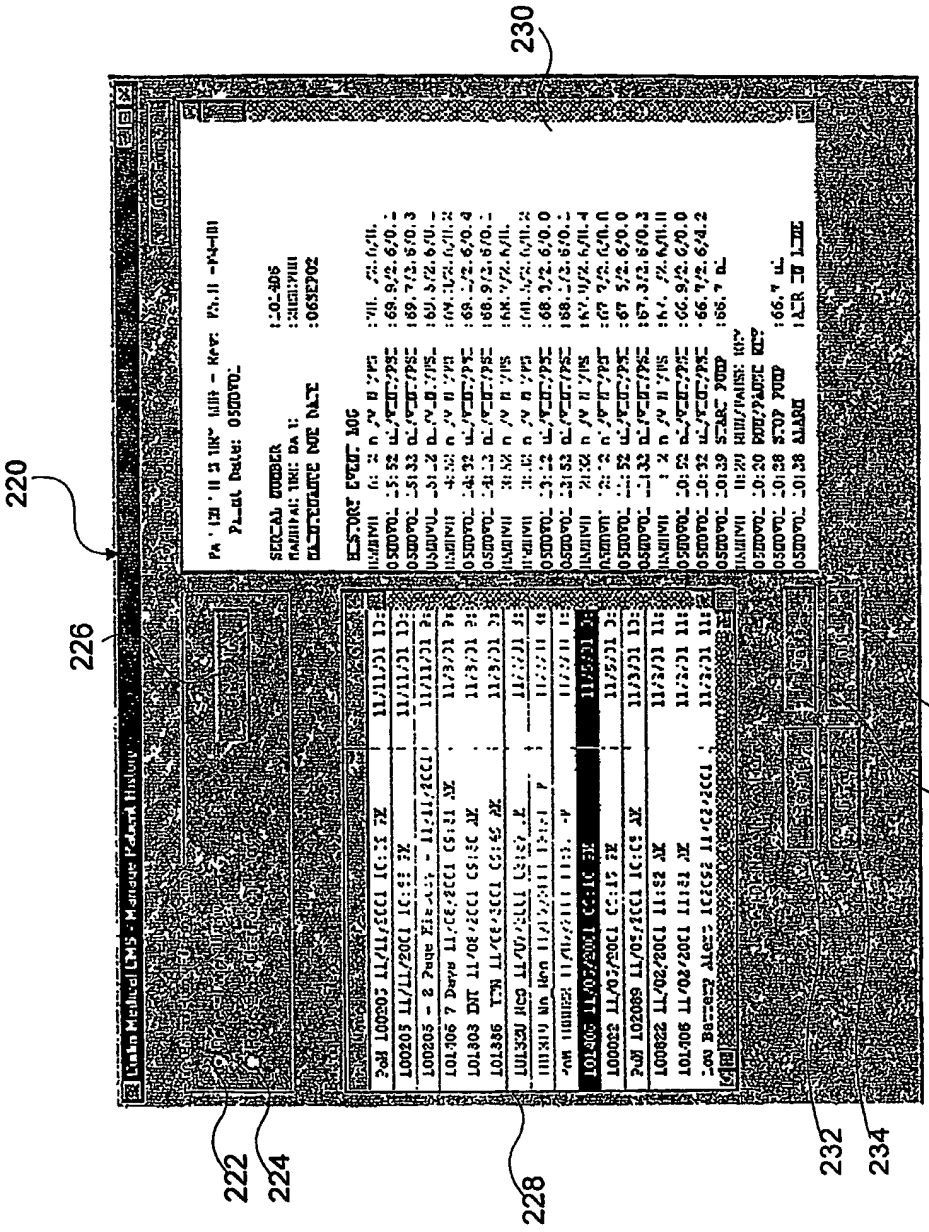

Fig. 7

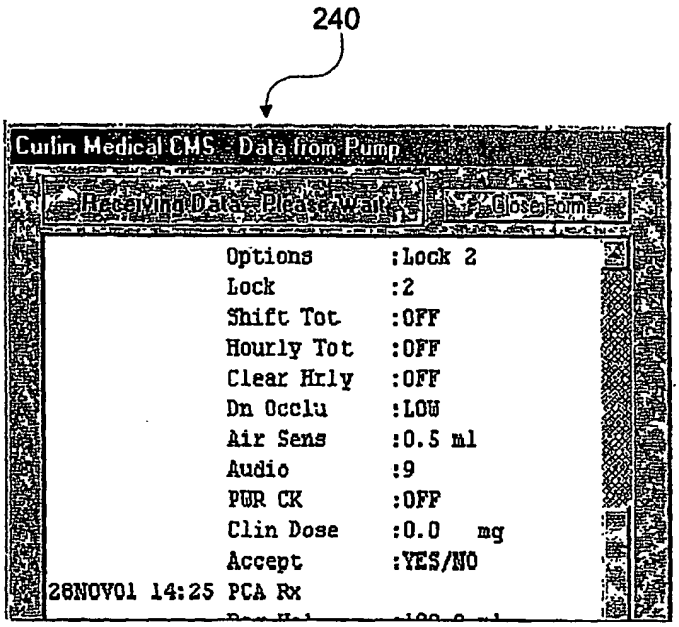
240
Curlin Medical CMS - Data from Pump
Receiving Data, Please Wait
Close Form
Options :Lock 2
Lock :2
Shift Tot :OFF
Hourly Tot :OFF
Clear Hrly :OFF
Dn Occlu :LOW
Air Sens :0.5 ml
Audio :9
PWR CK :OFF
Clin Dose :0.0 mg
Accept :YES/NO
26NOV01 14:25 PCA Rx

Fig. 8

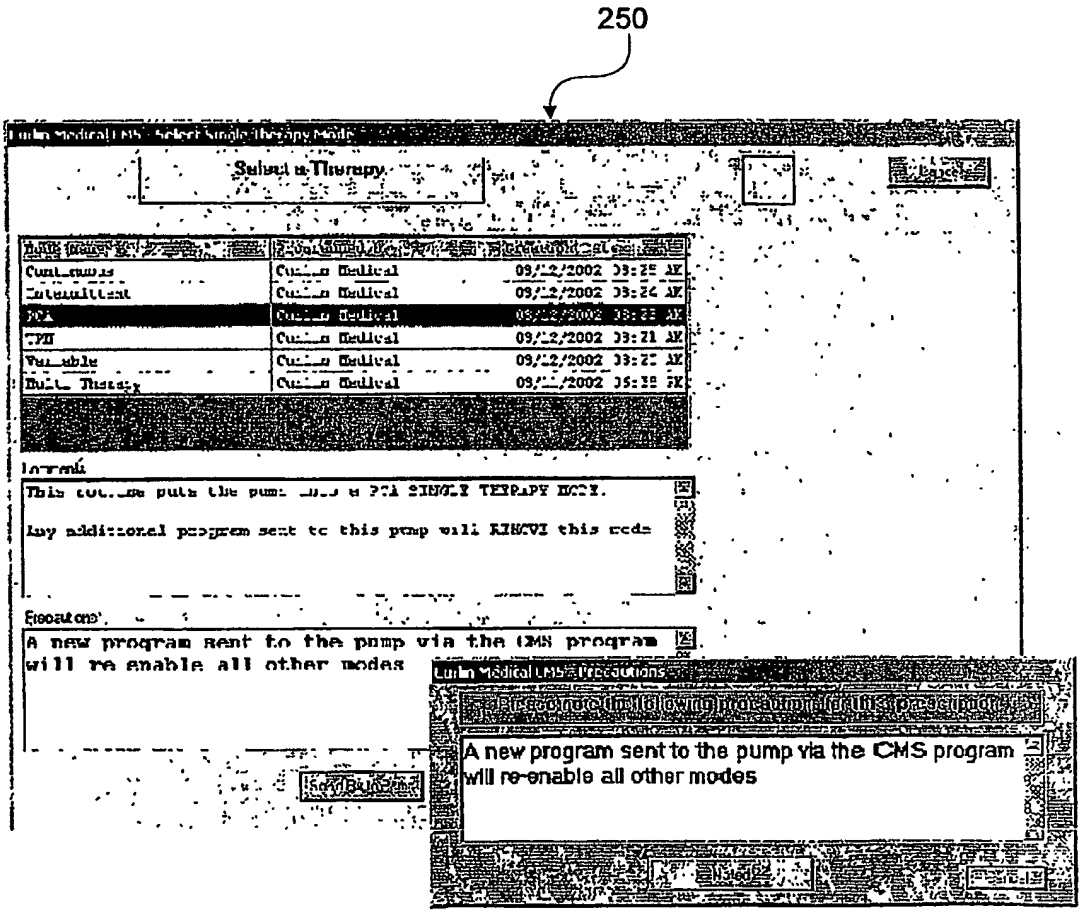
250
Select a Therapy
A new program sent to the pump via the CMS program will re-enable all other modes

Fig. 9